CubeSat Form Factor Thermal Control Louvers

Completed Technology Project (2013 - 2015)

Project Introduction

As small spacecraft become a part of NASA's repertoire of missions, one reoccurring theme is an increased need for thermal control as power budgets increase and tight instrument temperature tolerances are introduced on smaller platforms. Until now CubeSats have not needed thermal control outside of resistive heaters due to the low power and short lifespan of most CubeSat missions. However, in the past few years CubeSat solar panels have been developed by private companies which can produce up to 80W of power for a 3U (30X10X10 cm) spacecraft. Now CubeSat and small satellite missions are being proposed which rise to meet this new technological envelope, with high power instruments and multiple months or years of mission life. Therefore it is critical that a thermal control system be designed for small spacecraft missions, particularly CubeSats. The CubeSat Form Factor Thermal Control Louvers use passive thermal control to significantly improve the internal thermal stability of small spacecraft, creating a difference of several watts in dissipated heat between open and closed louvers.

Thermal control of small spacecraft, including CubeSats, is a challenge for the next era of NASA spaceflight. Science objectives and components will still require strict thermal control while smaller volumes will inherently absorb and shed heat more quickly than a larger body. Thus, game-changing technologies must be developed to stabilize the thermal environment inside of small spacecraft. Developing this technology will help place Goddard at the forefront of thermal control expertise in the fast-growing arena of smallsats and CubeSats.

The proposed CubeSat louver assembly will be based upon the proven designs of full-sized louvers for large spacecraft. Internal spacecraft components will be thermally coupled to the side of the spacecraft. Bimetallic springs serve as a passive control mechanism for opening and closing flaps. As the spacecraft heats up the springs expand due to the difference in thermal expansion rates of their two fused metals (hence bimetallic). This opens the flaps, changing the thermal radiation properties of the exterior surface. As the spacecraft cools the flaps close and return the exterior surface to the previous emissivity. These temperature-driven adjustments create a more stable thermal environment for components.

Analysis of the thermal louvers assumed that the louvers were in darkness, either shielded by the solar panels or facing deep space. The hand calculations of power dissipated via the thermal louvers shows a substantial difference between fully closed and fully open louvers at the high temperatures significant for electrical components.

Anticipated Benefits

Thermal control of small spacecraft, including CubeSats, is a challenge for the next era of NASA spaceflight. Science objectives and components will still

This image depicts a 6U CubeSat with rows of CubeSat thermal louvers on the side behind the deployed solar panels.

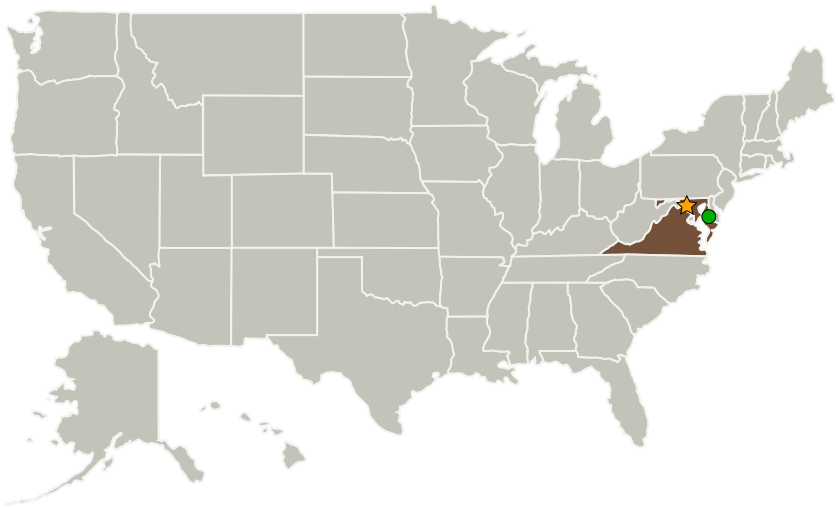
Table of Contents

CubeSat Form Factor Thermal Control Louvers

Completed Technology Project (2013 - 2015)

require strict thermal control while smaller volumes will inherently absorb and shed heat more quickly than a larger body. Thus, game-changing technologies must be developed to stabilize the thermal environment inside of small spacecraft. Developing this technology will help place Goddard at the forefront of thermal control expertise in the fast-growing arena of smallsats and CubeSats.

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Goddard Space Flight Center(GSFC)	Lead Organization	NASA Center	Greenbelt, Maryland
●Wallops Flight Facility(WFF)	Supporting Organization	NASA Facility	Wallops Island, Virginia

Primary U.S. Work Locations	
Maryland	Virginia

Organizational Responsibility

Responsible Mission Directorate:

Mission Support Directorate (MSD)

Lead Center / Facility:

Goddard Space Flight Center (GSFC)

Responsible Program:

Center Independent Research & Development: GSFC IRAD

Project Management

Program Manager:

Peter M Hughes

Project Manager:

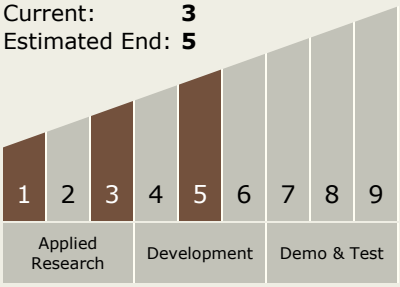
Dennis W Woodfork

Principal Investigator:

Allison L Evans

Technology Maturity (TRL)

Start: **1**
Current: **3**
Estimated End: **5**



CubeSat Form Factor Thermal Control Louvers

Completed Technology Project (2013 - 2015)

Images

CubeSat Form Factor Thermal Control Louvers
This image depicts a 6U CubeSat with rows of CubeSat thermal louvers on the side behind the deployed solar panels.
(https://techport.nasa.gov/image/2664)

Project Website:

http://aetd.gsfc.nasa.gov/

Technology Areas

Primary:

- TX14 Thermal Management Systems
  - TX14.2 Thermal Control Components and Systems
    - TX14.2.3 Heat Rejection and Storage